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British Floras

By G. A. NELSON, *Lecturer*

(*Received* 2nd *April* 1957)

(*Communicated by* Professor R. D. PRESTON, F.R.S.)

Accounts of the native plants of particular districts or countries are now innumerable. The title *Flora* for such was first used by Johan Linder for his *Flora Wiksbergensis* published in Stockholm in 1716. Later works bearing the word *Flora* in the title ranged from mere lists of the names of plants in a particular district to treatises on the history of the vegetable products of a locality, or even to collections of elaborate hand-coloured plates with little descriptive text.

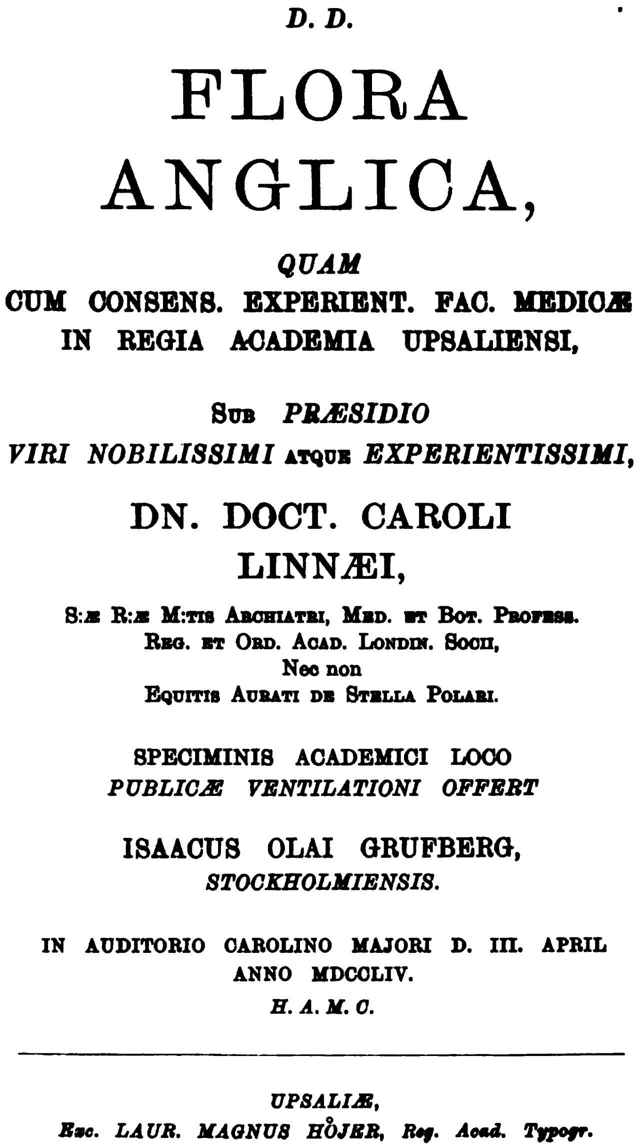
Localities are given for few plants in the earliest list of British plants — William Turner's *Libellus* (1538) — and in his *Names of Herbes* (1548). Localities for many more species appeared in his *Herbal* (1551 to 1568) and in Gerard's *Herbal* (1597). The first printed lists of plants of specific localities were those of Thomas Johnson's *Itinera Botanica* (1632 and 1634).

The earliest British Flora — in the sense of a work incorporating plant descriptions and habitats — is William How's *Phytologia Britannica*, printed in London in 1650. About 1250 species, including several exotic plants in general cultivation, are listed in alphabetical order. Numerous errors of nomenclature occur, as is common in pioneer works. How died in 1656, aged 37, but his catalogue formed the basis of Merrett's *Pinax Rerum Naturalium Britannicarum* printed in London in 1667. This might have been expected to be a better work than it is. Apart from much assistance from friends, Merrett had available not only How's work, but also Ray's *Catalogue of Cambridge Plants* published in 1660. Merrett's plan and arrangement are the same as How's. The number of plants listed is only a few more; several species and varieties are added, but some given by How are unaccountably omitted.

With the publication in 1670 of Ray's *Catalogus Plantarum Angliae et Insularum adjacentium* previous floras were superseded. A second edition appeared in 1677 and a *Fasciculus* of newly discovered British plants was added as a supplement in 1688. Although still in alphabetical order, the plants are more accurately and abundantly described. Meanwhile, by 1682, Ray had devised a system of classification, which he used in his *Synopsis Methodica Stirpium Britannicarum* of 1690. This is the earliest attempt to arrange British plants in systematic order. A second edition, considerably enlarged, appeared in 1696, and a third edited by Dillenius in 1724. This third edition was long the standard flora for British botanists in spite of less accurate synonymy than in previous editions.

Other attempts to provide a British flora were the elder Martyn's (1732) adaptation, in English, of Tourneforts' *History of plants of the Paris environs with* *many additional British records*, and John Wilson's *Synopsis of British Plants*— on Ray's system— published in Newcastle in 1744.

Linnaeus' system of classification and his binomial nomenclature were by this time in being : they appeared, fully developed, in his *Species Plantarum* of 1753. No more were long descriptive Latin diagnoses required for an identification and floras at once took on a new look.



D. D.

FLORA
ANGLICA,

QUAM
CUM CONSENS. EXPERIENT. FAC. MEDICÆ
IN REGIA ACADEMIA UPSALIENSI,

SUB *PRÆSIDIO*
VIRI NOBILISSIMI ATQUE *EXPERIENTISSIMI*,

DN. DOCT. CAROLI
LINNÆI,

S:Æ R:Æ M:TIS ARCHIATRI, MED. ET BOT. PROFESS.
REG. ET ORD. ACAD. LONDIN. SOCII,
Nec non
EQUITIS AURATI DE STELLA POLARI.

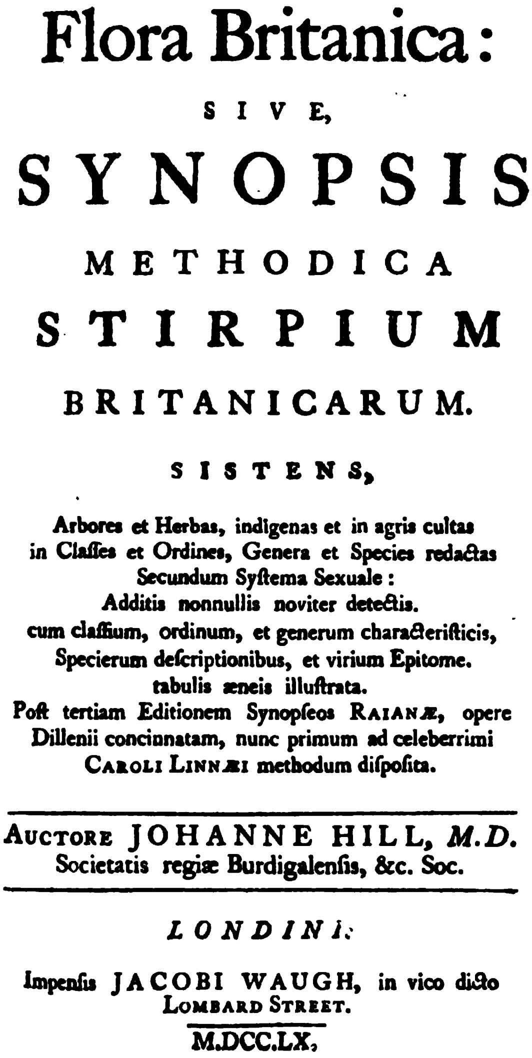
SPECIMINIS ACADEMICI LOCO
PUBLICÆ VENTILATIONI OFFERT

ISAACUS OLAI GRUFBERG,
STOCKHOLMIENSIS.

IN AUDITORIO CAROLINO MAJORI D. III. APRIL
ANNO MDCCLIV.
H. A. M. C.

UPSALIÆ,
Exc. LAUR. MAGNUS HÖJER, Reg. Acad. Typogr.

PLATE I



Flora Britanica:

SIVE,

SYNOPSIS

METHODICA

STIRPIUM

BRITANICARUM.

SISTENS,

Arbores et Herbas, indigenas et in agris cultas
in Claſſes et Ordines, Genera et Species redactas
Secundum Syſtema Sexuale:
Additis nonnullis noviter detectis.
cum claſſium, ordinum, et generum characteriſticis,
Specierum deſcriptionibus, et virium Epitome.
tabulis æneis illuſtrata.
Poſt tertiam Editionem Synopſeos RAIANÆ, opere
Dillenii concinnatam, nunc primum ad celeberrimi
CAROLI LINNÆI methodum diſpoſita.

AUCTORE JOHANNE HILL, *M.D.*
Societatis regiæ Burdigalenſis, &c. Soc.

LONDINI:

Impenſis JACOBI WAUGH, in vico dicto
LOMBARD STREET.
M.DCC.LX.

PLATE II

The earliest binomial flora of Britain is that of Linnaeus himself for, in a dissertation at Uppsala in 1754, he reassembled the British plants of Ray's *Synopsis* in accord with his own system and nomenclature. This was published as *Flora Anglica* (Plate I) and, though incomplete, would have been accounted the first Linnaean flora of Britain had it been more accessible. The name Isaacus Olai Grufberg, which appears on the title-page, is that of the student elected to defend the thesis. Such was the practice for all Swedish doctoral dissertations until 1855*.

---

* Personal communication from H. Sallander, Uppsala University Library.

British botanists early recognised the advantages of the new system and nomenclature, and books devoted to British plants soon appeared. The earliest attempt by an Englishman was the *Flora Britanica* (Plate II) of John Hill, an octavo volume of 672 pages published in 1760.

The work merits no more than to be classed as an attempt, for in botany, as in other fields, Hill essayed matters beyond his capacity. He did little more than re-arrange the material of Dillenius' edition of Ray's *Synopsis* in Linnaean order — often inaccurately. These works are similar even in format. In citing obsolescent plant-names — such as those of Bauhin and Gerard — without reference to the more modern Linnaean binomials, Hill missed the opportunity of forging ahead; but perhaps for once he recognised a task that was beyond his powers — that of equating the old titles with the new names. The *Flora*, indeed, reflects some of the character of this colourful personality.

The second son of the Rev. Theophilus Hill, John is said to have been born at Peterborough in 1716. On concluding his apprenticeship with a London apothecary, he set up for himself in St. Martin's Lane, Westminster, meanwhile studying botany with a view to increasing his profits. He was later employed in arranging the gardens and herbaria of the Duke of Richmond and of Lord Petre and he travelled Britain in search of the rarer plants, publishing his descriptions of them by subscription. After some attempts at playwriting, he returned to his vocation of apothecary, this time in James Street, Covent Garden. He was granted a diploma in medicine by the University of St. Andrews. Failing to obtain the requisite number of names for nomination to the Royal Society, he wrote several satirical pamphlets against that body in consequence.

Through Lord Bute's influence, Hill was appointed superintendent of the Royal Gardens at Kew, but the grant appears not to have been confirmed. He had his own gardens at Bayswater, on the site of Lancaster Gate, where he grew plants for the quack medicines which brought him a substantial fortune. This quackery — though he was now an M.D. of Edinburgh — and his puerile attempts at playwriting evoked the satire and ridicule of a number of eminent writers; typical of these is David Garrick's epigram.

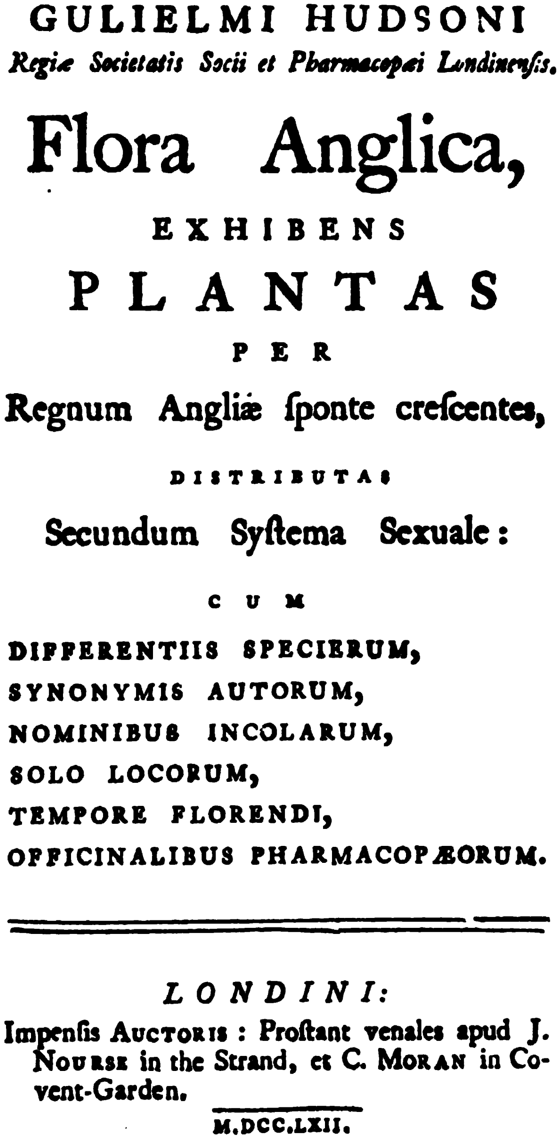
> 'For physics and farces, his equal there scarce is;
> His farces are physic, his physic a farce is.'

Hill's botanical writings were undertaken at the request of his patron, Lord Bute. They include many trashy compilations, some under pseudonyms, such as Abraham Johnson. His biggest work *The Vegetable System*, in 26 folio volumes, occupied him from 1759 to the year of his death. For it, in 1774, the King of Sweden awarded him the Order of Vasa. Thereafter, he was self-styled 'Sir' John Hill.

He was twice married; first to Miss Travers, daughter of Lord Burlington's house steward, and second, to the Hon. Henrietta Jones, sister of Charles, 4th Viscount of Ranelagh, who survived him. Hill died on 21st November 1775 of gout, for which he professed to have an infallible cure. A volume of 100 specimens of British plants, preserved by him 'in a manner which prevents the common misfortune of their being destroyed by insects' is in the British Museum.

The second post-Linnaean British flora was the *Flora Anglica* of William Hudson, published in octavo in 1762 (Plate III). This was a more exact work than Hill's and, according to Smith (1824), it 'marks the establishment of Linnaean principles of Botany in England'.

Hudson travelled little and so had little or no experience as a field botanist; his habitats are consequently ecological rather than topographical. The *Flora* was compiled under the auspices and advice of Benjamin Stillingfleet — the original 'blue stocking' from his manner of dress — who no doubt provided most of the specific localities of the rarer species. Linnaean binomial names are used, equated



GULIELMI HUDSONI
Regiæ Societatis Socii et Pharmacopæi Londinenſis.

Flora Anglica,
EXHIBENS
PLANTAS
PER
Regnum Angliæ ſponte creſcentes,
DISTRIBUTAS
Secundum Syſtema Sexuale:
CUM
DIFFERENTIIS SPECIERUM,
SYNONYMIS AUTORUM,
NOMINIBUS INCOLARUM,
SOLO LOCORUM,
TEMPORE FLORENDI,
OFFICINALIBUS PHARMACOPÆORUM.

LONDINI:
Impenſis AUCTORIS: Proſtant venales apud J. NOURSE in the Strand, et C. MORAN in Covent-Garden.
M.DCC.LXII.

PLATE III

with names used by many pre-Linnaean authors. The common English names and the Pharmacopoeial names of those plants which were then in the *materia medica* are also cited. The text, like Hill's, is in Latin.

William Hudson was born at the White Lion Inn, Kendal, which his father kept from 1730 to 1732. He was educated at Kendal Grammar School and gained the prize for botany given by the Apothecaries' Company — a copy of Ray's *Synopsis* which is now in the British Museum. He was apprenticed to a London apothecary, but during 1757 and 1758 was resident sub-librarian of the British Museum. Here his studies in the Sloane Herbarium enabled him to adapt Linnaean nomenclature, far more accurately than had Hill, to the plants described by Ray. In 1761 he was elected F.R.S. and his *Flora* appeared in the following year when he was in practice as an apothecary in Panton Street, Haymarket. From 1765 to 1771 he acted as *praefectus horti* to the Apothecaries' Company at Chelsea. In 1778 he issued a considerably enlarged edition of his *Flora*. Sir T. G. Cullum, Bart, had begun an English Flora on the Linnaean system in 1774 but, on the appearance of Hudson's second edition, it was discontinued although 104 pages were printed. A fire at Hudson's house in Panton Street in 1783 destroyed a great part of his collections. He retired to Jermyn Street, and in 1791 joined the newly established Linnean Society. He died of paralysis at his Jermyn Street house on 23rd May 1793 in his 60th year. He had bequeathed his herbarium to the Society of Apothecaries. The year of his birth is usually given as '1730?'; but, if the obituary is correct, it fixes the year as 1732, for his parents had left the inn where he was born by 1733. Linnaeus named a North American genus of the Cistaceae, *Hudsonia* in his honour.

A *Generic and Specific Description of British Plants* by James Jenkinson was published in octavo in Kendal in 1775. This is a translation from the *Genera* and *Species Plantarum* of Linnaeus and, as it excludes all trees and grasses, it is not further discussed in this collocation of British floras.

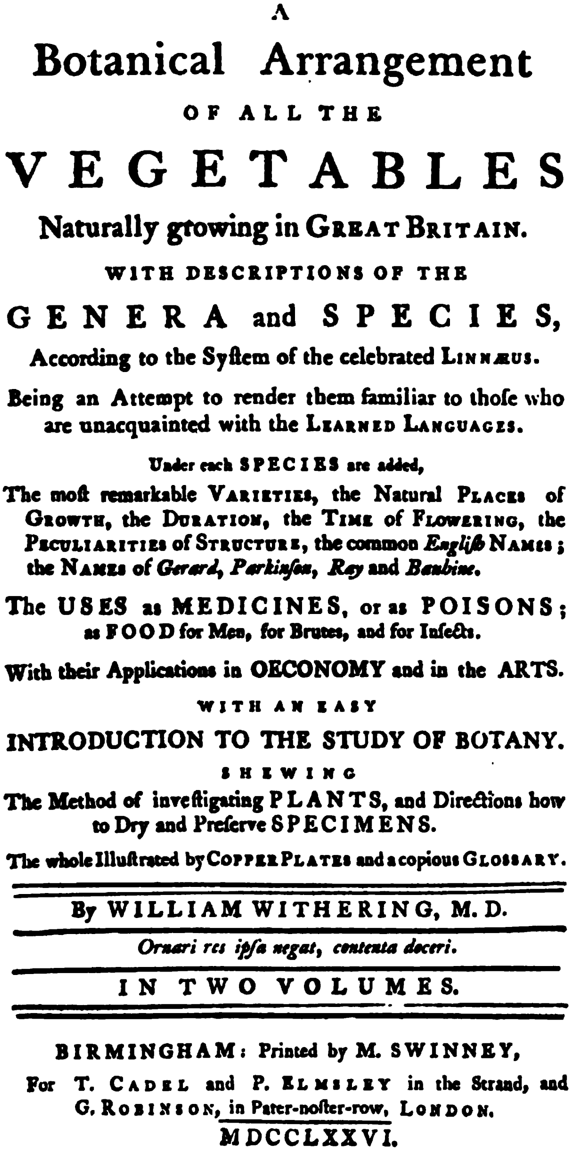
The third British flora was that of William Withering (Plate IV). It arose from a desire to encourage one of his first patients in the prosecution of her skilful sketches of plants. There are several reasons for the immediate and enduring popularity of this work. It was the first flora to be written in English. It was designed for young ladies and appeared at a time when they were becoming emancipated and were seeking for subjects of study suitable to their leisure and abilities. It was easily comprehensible, being written in a clear and precise style — in fact, the 'telegram' style, following Linnaeus' lead. It was not so much a lengthy descriptive treatise on plants as a handy guide to their identification, and as such was ideally suited to its public. Withering, as the first compiler of such a work in English, was called upon to coin many words for various plant organs and, out of delicacy for the susceptibilities of his fair readers, refrained from using such 'vulgar' words as stamens and carpels; these were 'chives' and 'pointals'. 'A Chive is composed of two parts, the Thread and the Tip, but the Tip is the essential part.' These bowdlerisms were dropped in later issues and the then current technical names were substituted.

Withering worked on his flora throughout his life, constantly adding new information with each succeeding edition — the first edition is almost devoid of specific localities. From the mid-1780's he employed two professional plant collectors to keep the work up to date. Afzelius, one of his many distinguished botanist visitors, revised his herbarium in preparation of the third edition, issued in 1796, the last edition to be published during his lifetime.

This appeared in octavo in May 1776. Further editions appeared as follows —

2nd ed. 1787	A botanical arrangement of British plants . . . 2 vols. 8vo. Birmingham, with a third volume, dealing with cryptogams, 1792. 'Much improved by Dr. Jonathan Stokes.'
3rd ed. 1796	An arrangement of British plants . . . 4 vols. 8vo. Birmingham.
4th ed. 1801	A systematic arrangement of British plants . . . 4 vols. 8vo. London. First posthumous edition. Corrected and enlarged by William Withering (the Younger).

5th ed. 1812	A systematic arrangement of British plants . . . 4 vols. 8vo. Birmingham. Corrected and considerably enlarged by William Withering (the Younger).
6th ed. 1818	An arrangement of British plants . . . 4 vols. 8vo. London. Enlarged by William Withering, F.L.S.
7th ed. 1830	An arrangement of British plants . . . 4 vols. 8vo. London. By William Withering, Esq. LL.D. F.L.S.



A
Botanical Arrangement
OF ALL THE
VEGETABLES
Naturally growing in GREAT BRITAIN.
WITH DESCRIPTIONS OF THE
GENERA and SPECIES,
According to the Syſtem of the celebrated LINNÆUS.
Being an Attempt to render them familiar to thoſe who
are unacquainted with the LEARNED LANGUAGES.
Under each SPECIES are added,
The moſt remarkable VARIETIES, the Natural PLACES of
GROWTH, the DURATION, the TIME of FLOWERING, the
PECULIARITIES of STRUCTURE, the common *Engliſh* NAMES;
the NAMES of *Gerard*, *Parkinſon*, *Ray* and *Bauhine*.
The USES as MEDICINES, or as POISONS;
as FOOD for Men, for Brutes, and for Inſects.
With their Applications in OECONOMY and in the ARTS.
WITH AN EASY
INTRODUCTION TO THE STUDY OF BOTANY.
SHEWING
The Method of inveſtigating PLANTS, and Directions how
to Dry and Preſerve SPECIMENS.
The whole Illuſtrated by COPPER PLATES and a copious GLOSSARY.

By WILLIAM WITHERING, M. D.

Ornari res ipſa negat, contenta doceri.

IN TWO VOLUMES.

BIRMINGHAM: Printed by M. SWINNEY,
For T. CADEL and P. ELMSLEY in the Strand, and
G. ROBINSON, in Pater-noſter-row, LONDON.
MDCCLXXVI.

PLATE IV

Peck and Wilkinson (1950) mention editions of 1805 and 1823; these are probably reprints. The eighth edition listed by Pritzel does not exist; it is the first edition of a one-volume condensation, by William Macgillivray, published in London, in 1830. Thereafter this condensation supplanted the original work, and judging by the frequency with which new editions appeared, seems to have been even more popular. All were one-volume editions, published in London —

1st ed. A systematic arrangement of British plants . . . Corrected and condensed by W. Macgillivray . . . One vol. 4to* London.

2nd ed.* 1833; 3rd 8vo*, 1835; 4th, 8vo, 1837; 5th, 8vo, 1841; 6th, 8vo, 1845; 7th, 8vo, 1848; 8th, 8vo, 1852; 9th, ; 10th, 12mo, 1858; 11th, 12mo, 1863; 12th, ; 13th, sm. 8vo, 1872; 14th, 1877. In spite of much search, details of the 9th and 12th editions remain untraced.

The titles vary slightly in the different editions; spines in many read 'Withering's British Plants by Macgillivray'.

William Withering (1741–1799) was the second child and only son of Edmund Withering(s), apothecary of Wellington, Salop, and of his wife Sarah née Hector. He was born at Wellington on the 17th March 1741†, recorded as 28th March 1741 on his mural monument at Edgbaston. This apparent discrepancy is accounted for by the omission of 11 days from the calendar during Withering's life — the day after the 2nd September 1752 was called the 14th.

He was educated at home and by the Rev. H. Wood, of Ercall. In due course, he was apprenticed to his father, but, from the outset, with the object of becoming a physician not an apothecary. There is nothing unusual in this, as Peck and Wilkinson (1950) suggest, for then, as now, qualified apothecaries were statutorily recognised as medical practitioners and many of those apprenticed to, or actually qualified as, apothecaries proceeded to become Licentiates of the Royal College of Physicians of London. In the autumn of 1762 he began his medical studies at Edinburgh under such eminent men as Alexander Munro, *secundus*, William Cullen, and John Hope. It was Hope who, in re-organising the College herb garden and arranging the plants on the Linnaean system, introduced Withering to the new taxonomy. The pupil was not enthusiastic, for he writes of ' . . . the disagreeable ideas I have formed of the study of botany' (Cushny, 1915).

After admission as M.D, in July 1766, he visited Paris. In the following year he set up in practice as a physician in Stafford. Here he was instrumental in starting the Staffordshire Infirmary and was appointed its first physician. One of his earliest patients was a girl of 17 years, Helena Cooke(s), whose flower sketches so inspired him that he gathered specimens of the local flora for her and thus laid the foundations of a dual and lifelong interest. They married five years later. Withering moved to a larger practice in Birmingham in 1775 and was physician to the General Hospital for 13 years (1780–1792). He was interested in chemistry and carried out researches to combat what he called "that monster Phlogiston". This work he passed over to Priestley. In 1784, Withering recognised the difference between a certain ore and barytes. The ore proved to be barium carbonate and in 1796 was named *Witherite* in his honour, by the German chemist Werner. Withering was elected F.R.S. in 1784 and moved to Edgbaston Hall two years later. It was here that he completed the second edition of his Botanical Arrangement. He died on 6th October 1799 after a long illness, during which it was wittily said that 'the flower of English botany is indeed Withering'. He was buried at Edgbaston where his monument bears a bust and includes a foxglove in its ornamentation.

Two children survived him, Charlotte and William (1775–1832) who edited later editions of his father's flora.

A genus of the Solanaceae was named *Witheringia* by L'Heritier.

Withering's other works were — his inaugural dissertation '*de Angina Gangraenosa*' Edinburgh, 1766; *An Account of the Scarlet Fever and Sore Throat, or*

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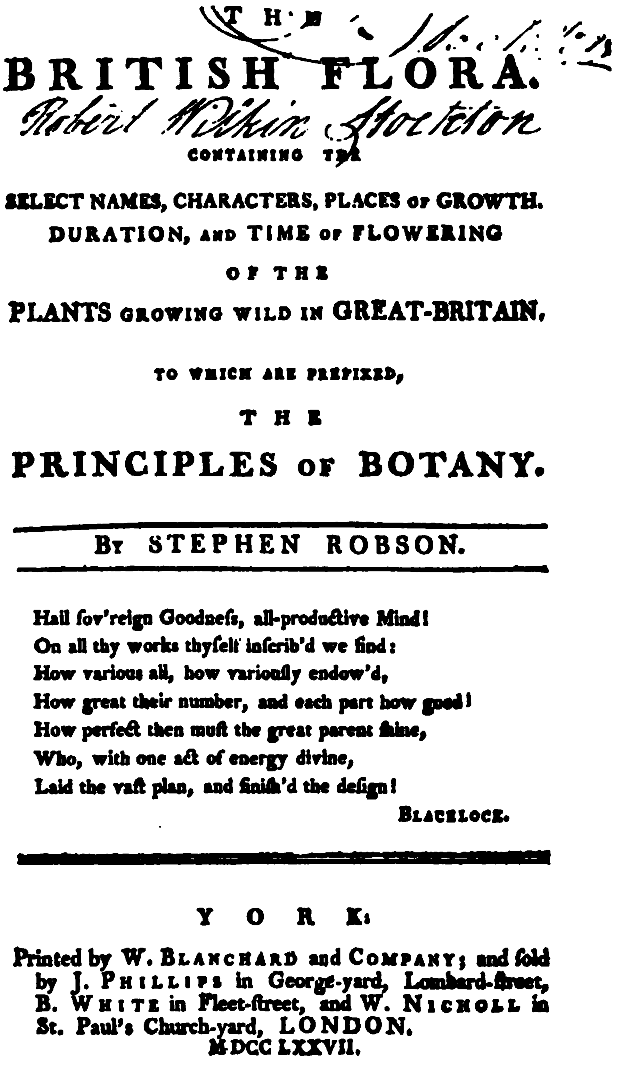
* Listed as 12mo in the Edinburgh University Library Catalogue.

† So given in his Memoir.

Scarlatina anginosa, 1778, 2nd ed. 1793; and his famous *An Account of the Foxglove and some of its medicinal uses*, Birmingham, 1785; facsimile ed. (limited to 250 copies) The Broomsleigh Press (Fudge & Co. Ltd.) London n.d. (16th July 1948).



THE
BRITISH FLORA.
Robert Wilkin Stockton
CONTAINING THE
SELECT NAMES, CHARACTERS, PLACES OF GROWTH.
DURATION, AND TIME OF FLOWERING
OF THE
PLANTS GROWING WILD IN GREAT-BRITAIN,
TO WHICH ARE PREFIXED,
THE
PRINCIPLES OF BOTANY.

BY STEPHEN ROBSON.

Hail ſov'reign Goodneſs, all-productive Mind!
On all thy works thyſelf inſcrib'd we find:
How various all, how variouſly endow'd,
How great their number, and each part how good!
How perfect then muſt the great parent ſhine,
Who, with one act of energy divine,
Laid the vaſt plan, and finiſh'd the deſign!
BLACKLOCK.

YORK:
Printed by W. BLANCHARD and COMPANY; and ſold
by J. PHILLIPS in George-yard, Lombard-ſtreet,
B. WHITE in Fleet-ſtreet, and W. NICHOLL in
St. Paul's Church-yard, LONDON.
MDCC LXXVII.

PLATE V

Stephen Robson, compiler of the fourth British flora, was the first 'amateur' to attempt such a work. His *British Flora* in one 8vo volume (Plate V) is of special interest on this account and also from his more frequent references to exact localities, especially in northern counties; but it is inferior to those of Hudson and Withering because of his reversion to Ray's outmoded systematics. As the work of a self-taught man, it is of great merit — especially as Robson was unacquainted with Withering's flora*.

Stephen Robson (1741–1779) was the second son of Thomas Robson, linen manufacturer of Darlington, and of Mary Hedley, his third wife. Stephen succeeded to the family business on his father's death in 1771. He also inherited a freehold house and shop in Northgate where he traded as a grocer. Entirely self-taught, he became a good scholar of Greek, Latin, and French and was specially interested in botany, astronomy, and heraldry. The flora was Robson's chief work, but he also wrote *Plantae rariores agro Dunelmensi indigenae*, privately printed and now a scarce work. He had as friend and mentor Robert Harrison, the orientalist of Durham, whose assistance with the flora he acknowledges; Robson also corresponded with William Curtis of *Flora Londinensis* fame.

In 1771 he married Ann Awmack and he died at Darlington of pulmonary tuberculosis on 16th May 1779.

The compilation of Britain's fifth flora in 1800 by J. E. Smith was a direct result of his snap purchase of the Linnaean manuscripts and collections. Possession of this material placed him in a unique position, and his flora must surely have superseded Withering's had it been drafted on similar popular lines. Smith, however, wrote for a different reader — for the educated, scientific minority. Although Latin was then fading as the language of science, Smith reverted to it for his text.

The work in three octavo volumes is a British 'Species Plantarum' (Plate VI), being Linnaean both in style and format, with considerable expansion in the plant descriptions. Specific localities are more numerous than in any earlier British flora.

James Edward Smith (1759–1828) was born at Norwich, on 2nd December 1759, the eldest child of James Smith, wool merchant and of his wife, Frances, only daughter of the Rev. John Kinderley. Being delicate, James was educated at home and learned the love of flowers from his mother. He began scientific studies when 18 years old, and although originally intended for commerce, went to Edinburgh University in 1781 to read medicine. Here he studied under Dr. John Hope, whose influence on Withering has been previously mentioned, was awarded the Hope gold medal and founded a Natural History Society. In September 1783 he transferred to London for further study, armed with an introduction from Hope to Sir Joseph Banks, then President of the Royal Society. Banks was offered Linnaeus' library and collections on the death of the younger Linnaeus in 1783, and declining, they were purchased by Smith with his father's consent.

Once the collections were housed in his apartments at Paradise Row, Chelsea (October 1784) Smith devoted his whole time to natural history, mainly botany, but without thought of relinquishing medicine as his profession. As owner of such valuable material, he was urged to compile 'a Flora Britannica, the most correct that can appear in the Linnean dress'. He was elected F.R.S. in 1785 and, during a continental tour, obtained a medical degree at Leyden for a thesis *De Generatione* in the year following. In 1785 he took a house in Great Marlborough Street and set up in practice as a physician. Meanwhile he proposed the formation of a vigorous natural history society, incorporating Linnaeus in its title. The first General Meeting of The Linnean Society of London took place at his house, 8th April 1788. Smith was first President of a Society of three Honorary Members, 20 Fellows, 39 Foreign Members and 11 associates (Gage, 1938).

In 1790 he began publication of his most famous work — Sowerby's English Botany — so called after the illustrator because Smith's name did not appear on the first three volumes. This work, of 36 octavo volumes, has 2592 plates of all the then known British plants except fungi. Publication was completed in 1814.

Smith married, in 1796, Pleasance, only daughter of Robert Reeve of Lowestoft, and soon after, they settled in Norwich. He now spent no more than two or three months each year lecturing in London, but he was annually elected President of the Linnean Society until his death. He was knighted in 1814 when the Prince Regent accepted Patronage of the Society. He died in Surrey Street, Norwich, on 17th March 1828, and was buried in his wife's family vault in Lowestoft. There were no children. His wife (1773–1877) survived him by almost half a century.

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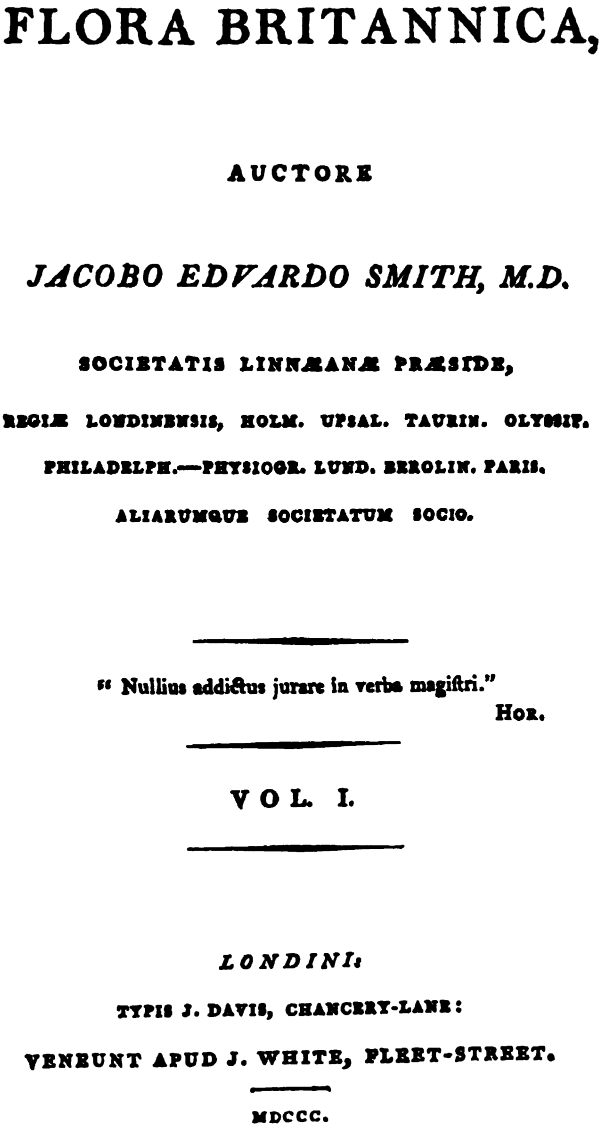
* Withering is not cited in the references and Robson states (Preface, p. ix) that some names 'in common use, *but not met with in botanical books*, are introduced, as Sedge and Archil'. Sedge is used by Withering, pp. 563–571 of the 1776 ed. (Author's italics).

He wrote many other works and edited the *Flora Graeca* for his friend John Sibthorp. Smith's last work, accounted his best, was *The English Flora* of which two volumes were issued in 1824, a further volume in 1825 and fourth in 1828. A 'Compendium' in one volume was issued posthumously the following year and a



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SOCIETATIS LINNÆANÆ PRÆSIDE,

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PHILADELPH.—PHYSIOGR. LUND. BEROLIN. PARIS.

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HOR.

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PLATE VI

further volume on mosses by Sir W. J. Hooker and fungi by the Rev. M. J. Berkeley is dated 1883–1886.

A second edition of Smith's work 'Sowerby's English Botany' was published in 12 octavo volumes, 1835–1846, and a third edition, systematically arranged, in 12 quarto volumes, 1863 to 1886, edited by J. T. Boswell Syme with a supplementary octavo volume in 1892, edited by N. E. Brown. Meanwhile, floras appeared with increasing frequency. Most worthy of mention are C. C. Babington's *Manual of British Botany* (1843), still extant in its 10th edition, revised by A. J. Wilmott in 1922; (W. J.) Hooker's *The British Flora* (1880), better known as Hooker and Arnott's *British Flora*, which it became in its 6th edition in 1850, and which, after its 8th edition in 1860, was replaced by (J. D.) Hooker's *The Student Flora* (1870) — 3rd edition 1884, 4th edition (unaltered) 1930. Bentham's *Handbook of the British Flora* in one volume, 1858, appeared in its second edition in two volumes (1863), with illustrations by W. Fitch; the 5th edition, 1886–1887, was revised by J. D. Hooker, and so became the familiar Bentham and Hooker's *British Flora*. In this and later editions the illustrations by W. H. Fitch and W. G. Smith were issued in a volume separate from the text. The text became, and remained, the standard flora until recent years. The illustrations reached a 5th edition in 1901, and a 'fifth revised' edition in 1924. In 1930, these were supplemented by *Further Illustrations of British Plants* by R. W. Butcher and F. E. Strudwick.

No comprehensive British flora appeared in the first half of the twentieth century. *The Cambridge British Flora* of C. E. Moss was intended to close the gap but publication was interrupted by the first world war and, of a work intended to cover our flora in about ten volumes, only two were issued—Vol. I, not issued; Vol. II, 1914 (*Salicaceae to Chenopodiaceae*), Vol. III, 1920 (*Portulacaceae to Fumariaceae*), each with a corresponding volume of plates by E. W. Hunnybun. All were published in folio by Cambridge University Press. Had the *Flora* been completed, it would have proved admirable for indoor work, but a comprehensive flora of portable size remained a desideratum until the appearance of *Flora of the British Isles* by Clapham, Tutin and Warburg in 1952, Cambridge University Press. This gave new impetus for field work to British botanists, who had been without an up-to-date and adequate handbook for over half a century.

I am indebted to Mr. A. B. Craven, Deputy City Librarian, Leeds, for his help in my search for the Withering-Macgillivray editions. My thanks are also extended to Professor W. A. Bain and Dr. G. A. Mogey for their interest and suggestions during the progress of the work.

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The Identification of the Nymphal and Imaginal Stages of the Stick Insect, *Carausius morosus* Brunner (Orthoptera)

By A. A. SAVAGE, *Research Assistant*

(*Communicated by* H. HENSON)

(*Received* 22*nd June* 1957)

INTRODUCTION

During the course of other work it was found necessary to identify the nymphal stages of the stick insect. The existing accounts of the life-history give conflicting data regarding the number of moults, from three to seven being recorded by different authors, and none give adequate descriptions which enable the individual instars to be identified.

In the present study it was found that there are seven instars, i.e. six moults, but before describing these the literature may be briefly reviewed. Talbot (1920) states that there are three moults, occasionally four, but the data for changes in body length at the moults and the range of variation in length in insects of the same stadium are of incredible proportions. De Sinéty (1901) observed only two specimens of which one had five moults and the other six but gives no data concerning the mode of observation. The evidence of both authors is weak and the results must be discounted. Pflugfelder (1937), Roth (1916), and Meissner (1909) state that there are six moults. Pflugfelder bred large numbers of insects which were used for experimental purposes and although there are not sufficient data the results appear quite convincing. The work of Roth is the most detailed study of the life-history available and his observations are supported by data concerning many body structures; in fact these results are the most reliable in the literature. Meissner obtained 300 reputed newly hatched nymphs which subsequently moulted six times but there is a possibility that the nymphs were already of the second instar and hence the results were not conclusive. Macbride and Jackson (1917) recorded seven moults; they bred large numbers of insects which were studied over a long period of time but again no data, except changes in body length, are given for distinguishing the instars.

In the literature reviewed there is no detailed account of morphological changes or valid statistical data for the identification of the individual instars and to this extent it is unsatisfactory. However, the results of Pflugfelder and Roth are convincing as regards the numbers of moults and therefore two populations possessing seven instars have been accurately observed. Other less convincing results suggest four, five, six or eight instars. It may also be noted that there is no evidence to suggest that variation in the number of instars, if real, is caused by, or correlated with different environmental conditions.

MATERIALS AND METHODS

There is little change in external morphology during the post-embryonic development of the stick insect except for increase in size and the form of the genitalia. For the identification of the instars head width is the easiest measurement to make with accuracy and, together with the form of the ovipositor and subgenital plate, has proved satisfactory.

The width of the head was measured at its widest point, just behind the eyes, at right angles to the longitudinal axis of the insect and in a horizontal plane. The genitalia were examined in about 20 specimens of each instar. It was found that there was little variation within the instar, but considerable differences between the instars.

The stick insects, which reproduce parthenogenetically, were reared in glass cylinders kept at 17 – 25 deg. C. and fed entirely on privet. The population was originally reared from eight adult females and always consisted of females. The eggs were collected, placed on sand in small pill boxes and occasionally moistened. The newly hatched nymphs were placed in a glass cylinder. When a nymph moulted it was transferred to a second glass cylinder until it again moulted, when it was transferred to a third — and so on. Thus the insects were reared in a series of cylinders each containing nymphs of a particular instar. The head width was measured after hatching and immediately after each moult before moving to the next container. A few individuals were reared in isolation and the head width was measured daily, no increase in size being noted except after each moult.

RESULTS

Carausius morosus Br. has seven instars, six nymphal and the imaginal, readily distinguishable from one another by head measurements and the form of the genitalia. The observed variation of the width of the head capsule in each instar never overlapped with that of adjacent instars. Statistically, the earlier instars are truly discontinuous but the later ones do show a slight overlap in calculated range. Thus any specimen may be referred to its correct instar by its head width (Table I).

TABLE I

The widths of the head in *Carausius morosus* (in units of 10μ)

Instar	Frequency	Observed Range	Calculated Range	Mean and Standard Error	Standard Deviation	Variability Coefficient	Growth Ratio
1	35	91–102	85–103	$94{\cdot}3 \pm 0{\cdot}508$	3·003	3·184	1·22
2	36	108–122	106–124	$115{\cdot}2 \pm 0{\cdot}505$	3·026	2·628	1·18
3	37	129–143	125–147	$136{\cdot}1 \pm 0{\cdot}607$	3·691	2·712	1·18
4	50	149–174	145–175	$159{\cdot}9 \pm 0{\cdot}710$	5·020	3·138	1·21
5	43	182–204	174–212	$192{\cdot}9 \pm 0{\cdot}949$	6·266	3·248	1·23
6	36	216–260	211–266	$238{\cdot}2 \pm 1{\cdot}528$	9·168	3·849	1·28
7 Imago	31	280–239	254–358	$306{\cdot}0 \pm 2{\cdot}820$	17·22	5·630	

The ratios of the head widths of the nymphal instars to one another are remarkably constant at about 1·20 and somewhat lower than the ratio between the sixth instar and the imago which is 1·28. In *Forficula* (Henson 1947) the ratios of the head widths of the nymphal stages were constant but higher than the ratio between the fourth instar and the imago.

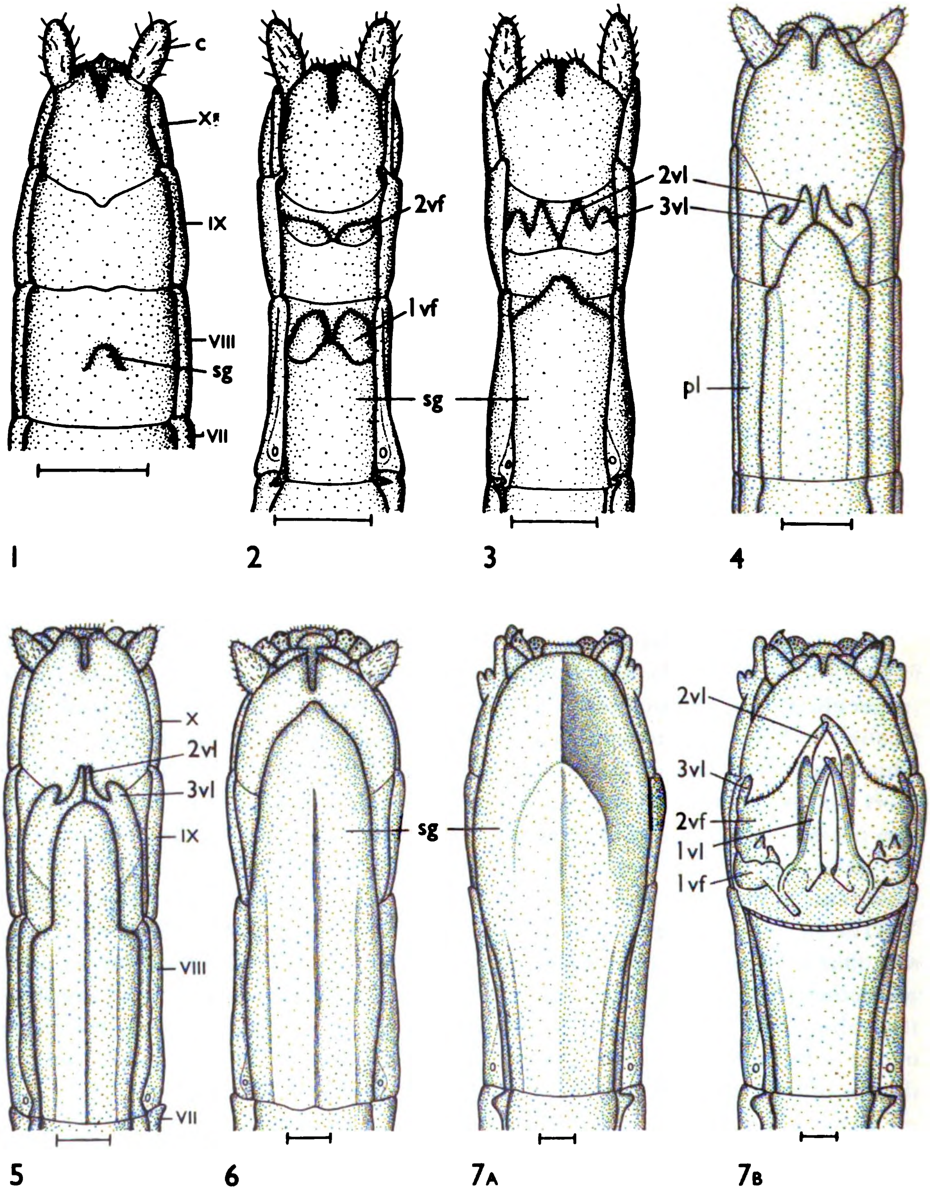
The female genitalia of the stick insect are basically of typical Orthopteran form (Snodgrass 1935) and consist of two main parts, the sub-genital plate (operculum) and the ovipositor proper. In the adult female the ovipositor consists of the first valvifers which carry the first valvulae; and the second valvifers which carry the second and third valvulae. The first and second valvulae are short, narrow, blade-like structures whilst the third valvulae are very small peg-like projections (Fig. 7B). The entire ovipositor is covered by the spoon-shaped sub-genital plate which extends almost to the tip of the abdomen (Fig. 7A). This plate is normally interpreted as a backward extension of the morphological VIIIth sternite (apparent VIIth). Since the form and size of these structures are characteristic of each instar they may be used for identification by mere inspection. The main criteria for identification of the instars are the length of the sub-genital plate relative to the VIIIth, IXth and Xth tergites, the shape of the sub-genital plate, the degree of development of the ovipositor, and the degree of covering of the ovipositor by the sub-genital plate (Figs. 1 – 7).

SUMMARY

The population of *Carausius morosus* Br. here described possesses seven instars. The identification of each instar is based on the form of the female genitalia and the head width.

Two other populations possessing seven instars have been described by previous authors. Other descriptions implying the existence of populations with four, five, six or eight instars are not very convincing.

There is no evidence to suggest that the variations in numbers of instars are related to environmental conditions.



LEGENDS FOR FIGURES

Ventral views of the hind end of the abdomen. Figs. 1–6, 1st – 6th nymphal instars. Fig. 7A, Imago intact. Fig. 7B, Imago with distal portion of the sub-genital plate removed. c, cercus; pl, pleurite; sg, sub-genital plate; 1vf, 2vf, 1st and 2nd valvifers; 1vl, 2vl, 3vl, 1st – 3rd valvulae; VII, VIII, IX, X, abdominal tergites.
Scale = 0·5 mm.

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